Mini-VREM
Mini-Virtual Reality Enhanced Mannequin

La Medicina Incontra la Realtà Virtuale – 3 Novembre 2011 Bologna

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Disclosure

**Federico Semeraro** - Anaesthetist /Geek
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Candidate Educator European Resuscitation Council

iCPR Scientific Advisor and Project Manager ([www.icpr.it](http://www.icpr.it))
Virtual Reality Enhanced Mannequin (VREM) for clinical risk management and healthcare personnel training in immersive simulation

La Medicina incontra la Realtà Virtuale: Applicazioni in Italia della Realtà Virtuale in Medicina e Chirurgia

Semeraro F.¹, A.Frisoli², M.Bergamasco², A.Maffei², E.L.Cerchiari¹

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Dedicated to the Next Generation

Andrea was born 20\textsuperscript{th} November 2010
20\textsuperscript{th} November 2010 6.35 his first photo with iPhone

21\textsuperscript{st} November 2010 Andrea’s Secret Facebook Group
23\textsuperscript{th} November 2010 Andrea slept with music from iPod
Where is exactly the line between reality and fiction?
Fiction or Reality

Star Trek 1966

Bluetooth 1999
Fiction or Reality

Blade Runner 1982
Philip K. Dick 1968

www.lightships.com
Fiction or Reality

Total Recall 1990
Philip K. Dick 1968

Body Scanner 2008
Fiction or Reality

Minority Report 2002
Philip K. Dick 1956

G Speak 2008
Fiction or Reality

Star Trek 1966

www.mediject.com
Sudden cardiac arrest is responsible for more than 60% of adult deaths from coronary heart disease. The actions linking the victim of sudden cardiac arrest with survival are called:

**Chain of survival**

2/3 of cardiac arrests that occur outside of hospital occur in the home, and that nearly half that occur in public are witnessed by bystanders.

Time is Life

Survival Rate (percent)

Survival reduced by ~7-10% each minute defibrillation delayed

Waalewijn RA et al. Resuscitation 2001
The most popular method of training in basic life support and AED use remains instructor-led training courses.

A recent review provides good evidence to support alternative methods of AED training including lay instructors, self-directed learning (web, video, poster) and brief training. Yeung J & Perkins GD. Resuscitation. 2011
Virtual Reality
(Attitude & Relationships)

Short communication

Virtual reality enhanced mannequin (VREM) that is well received by resuscitation experts

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Summary: The objective of this study was to test acceptance of, and interest in, a newly developed prototype of virtual reality enhanced mannequin (VREM) on a sample of congress attendees who volunteered to participate in the evaluation session and to respond to a specifically designed questionnaire.

Methods: A commercial Laerdal HeartSim 4000 mannequin was developed to integrate virtual reality (VR) technologies with specially developed virtual reality software to increase the immersive perception of emergency scenarios. To evaluate the acceptance of a virtual reality enhanced mannequin (VREM), we presented it to a sample of 39 possible users. Each evaluation session involved one trainee and two instructors with a standardized procedure and scenario: the operator was invited by the instructor to wear the data-gloves and the head mounted display and was briefly introduced to the scope of the simulation. The instructor helped the operator familiarize himself with the environment. After the patient’s collapse, the operator was asked to check the patient’s clinical conditions and start CPR. Finally, the patient started to recover signs of circulation and the evaluation session was concluded. Each participant was then asked to respond to a questionnaire designed to explore the trainee’s perception in the areas of user-friendliness, realism, and interaction/immersion.

Results: Overall, the evaluation of the system was very positive, as was the feeling of immersion and realism of the environment and simulation. Overall, 84.8% of the participants judged the virtual reality experience as interesting and believed that its development could be very useful for healthcare training.

Conclusions: The prototype of the virtual reality enhanced mannequin was well-liked, without interference by interaction devices, and deserves full technological development and validation in emergency medical training.
Mini-VREM
Mini-Virtual Reality Enhanced Mannequin
Mini-VREM Project

Purpose of the study
The main objective of the research project is the development of a low-cost training platform for quality cardiopulmonary resuscitation of lay and health care personnel, aimed at both retention (in particular chest compression and ventilation) and self-assessment of acquired skills.

Methods and materials
The proposed training platform is composed of a MiniVREM Manicardiac mannequin and two real-time markers placed on the wrists of the trainer, that will be automatically detected by a motion tracking software through one or two cameras, to monitor the trainer's hands position and posture while performing chest compressions.

The system will automatically record and analyze the movement features performed by the trainer, to assess the quality of the compressions in terms of compression rate and depth similar to the CPR training mannequin and the correct arm position and alignment with the manikin. An on-line feedback information will be provided during the training in view of operator markers, only visual feedback will be provided to the subject. In case of alert markers, a more precise estimate of the compression features will be achieved and also active visual feedback at the level of wrists will be provided to the trainers to synchronize the compression rate with the expected optimal one.

The training session will be also endowed with an augmented reality simulation, showing the current view from the camera embedded with two-realasive graphical information to improve the operator performance (force, feedback, and the 3D graphics representation of the manikin as a virtual character, allowing the detection of a deviating and correct standard position during exercise for choosing the proper application of ventilation.

Results presented in sufficient detail to support the conclusions
The project is designed to achieve the following objectives:
1. To develop a motion tracking software that will automatically detect the quality cardiopulmonary resuscitation for lay people and healthcare personnel for the maintenance of CPR skills and improve the perception of culture by adding visual information related to the patients conditions to the manikin virtually utilized in healthcare simulation software.
2. To design standardized training scenarios for training of lay people and healthcare personnel with and without abnormal reactions.

Conclusions
Organization of training programs needs to evolve to make full use of remoc technology.

Augmented reality is porentializing the characteristics of being holistic, interactive and imaginative, plays new and more important role in the medical field.

Motion detection technology as a tool for cardiopulmonary resuscitation (CPR) quality improvement

The most popular method of training in basic life support and automated external defibrillator training courses, current CPR courses provide good evidence to support alternative methods of training including Tele-training and self-directed learning with videos, posters and CPR feedback devices. We report here the results of the prototype testing of the previously described Mini-VREM project in the next world of video game using a tele-training system to improve the performance of CPR on a manikin. The system allows users to control the CPR training on a manikin with the help of a tele-training device which can be connected to the manikin via a USB hub. The system provides visual and audio feedback on the quality of the CPR performed by the user. The system can be used in different settings, such as training centers and hospitals, to improve the quality of CPR performed by healthcare professionals.
CPR prompt or feedback devices improve CPR skills acquisition and retention and may be considered during CPR training for laypeople and healthcare professionals. These devices may be considered for clinical use as part of an overall strategy to improve the quality of CPR.

Resuscitation 81S (2010) e1–e25
CPR prompt/Feedback devices
iCPR: a new and friendly application for cardiopulmonary resuscitation training

Simulations and education

iCPR: A new application of high-quality cardiopulmonary resuscitation training

Federico Senatore, Florian A. Taggi, Gaetano Timmaro, Cagliremo Imrich, Luca Martelli, Enzo L. Cerchiai

1. Introduction

The clinical importance of cardiopulmonary resuscitation (CPR) for the survival of cardiac arrest patients has been extensively reported. In fact, CPR significantly improves outcome. When performed by lay persons and healthcare professionals, CPR is effective within a few minutes after cardiac arrest. The quality of CPR is determined in the clinical setting, though the survival benefit of high-quality CPR is still debated.1-4

The European Resuscitation Council (ERC) guidelines emphasize the importance of high-quality, unassisted CPR and also specify a target compression depth of 4-5 cm and rate of 100-120 compressions per minute. A number of devices have been developed to guide providers during CPR training, and these have been used both in training and clinical settings.5-9

The device is an application specifically designed to prompt CPR training through a realistic simulation that includes feedback on the quality of chest compressions. The software can be used both on iPads and iPhones in an affordable and easy-to-use manner. This app provides users with immediate feedback on the quality of compressions, encouraging them to improve their performance and achieve higher-quality CPR.

2. Materials and method

We used an application specifically designed to guide CPR training through a realistic simulation that includes feedback on the quality of chest compressions. The software can be used both on iPads and iPhones in an affordable and easy-to-use manner. This app provides users with immediate feedback on the quality of compressions, encouraging them to improve their performance and achieve higher-quality CPR.
Gaming Platform
(Knowledge & Skill)

• Advantages
  – common in all age groups
  – easy to use
  – precision and motion-sensing capabilities
  – motion tracking feedback

• Disadvantages
  – field research in progress
  – development is still poorly defined
http://www.gamesforhealtheurope.org/
How users see the programmers

How programmers see the users
The American Heart Association has invested $50,000 to fund the work of University of Alabama at Birmingham (UAB) biomedical engineering undergraduate students who are working to develop a computer program that teaches CPR using hand-held remote controls from the Nintendo® Wii video game console.
Objective
The research project involves the development of a serious game specifically dedicated on quality cardiopulmonary resuscitation for lay people and healthcare personnel for learn and improve CPR skills (chest compression and ventilation) and for self-evaluation.

The proposed serious game is composed of a manikin/pillow for the physical interaction, Kinect Sensor Technology that will be used to reconstruct trainee’s hands position and posture while performing cardiopulmonary resuscitation.
Methods
The system will automatically extract and analyse the movement features performed by the trainee, to assess the trainee's performance in terms of compression rate and depth and the correct arms' position and alignment with the mannequin.
An on-line feedback correction will be provided during the performance.
1st Prototype 22 Oct 2011

Mini-VREM

F. Semeraro, A. Frisoli, C. Loconsole, F. Bannò, L. Marchetti, E.L. Cerchiari
### Session statistics

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Detection window

Definition of the 3D space in which the hands will operate

Maximum distance

The pixel that match the selected color are underlined with a saturated red

Tuning of the marker color hue

Tolerance to identify the correct color hue

Selected color hue

Save/load last parameters (when the application starts it loads last saved parameters)
Display window

The red circle indicates the tracked point
Statistics window

“Save statistics” saves this statistics plus others on the hard disk
“Save Log” saves every kind of information on pauses and compressions during the session
**Statistics window**

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Possibility of CPR training for general population directly at home

Retraining of healthcare professional

Teaching children CPR at school with Mini-VREM can create a new generation of lifesavers

Children learn and retain new skills more easily than adults and are also often present at emergencies
Next Step

- Find Money
- Create Serious Game
- Free online for everybody

Prospective Randomized Controlled Trial Comparing Basic Life Support (BLS) training with Mini-VREM versus Conventional Basic Life Support training and its Subsequent Impact on the Quality of CPR
Thanks to Project Team

Prof. Antonio Frisoli
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Claudio Loconsole & Filippo Bannò
PERCRO Laboratory
Scuola Superiore Sant'Anna, Pisa, Italy

Prof. Erga Cerchiari
President Italian Resuscitation Council

Luca Marchetti
CEO Studio Evil
Time is Life

![Graph showing the relationship between time to defibrillation and survival rate.](image)

**Survival reduced by ~7-10% each minute defibrillation delayed**

Waalewijn RA et al. Resuscitation 2001
Teach CPR
as soon as possible
Thank you for your attention

Mini-VREM project

Share and fund this project
www.kapipal.com/mini-vrem